Veterinary REPORT

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THE RESEARCH ISSUE

1
In Search of a PRRS Vaccine

4
Cancer Pain Study

19
Alumni, Industry Support for Research

In this issue

Features

Solving a Viral Mystery: 1

White Paper on PRRS Vaccine 2

Asthma Clues 3

Alleviating Bone Cancer Pain 4

Standards for Canine Lymphoma Diagnoses 6

Stem Cell Biology. 7

Keeping Microbes Out of Water Supplies 8

College News 10

Discoveries in the News. 12

Research Funding 14

Featured Faculty: Tom Graves 15

New Faces 16

Student Research 17

Current Clinical Trials 18

Advancement News 18

Faculty Directory 20

On the cover: Liz Estoff works in the research lab of Dr. Tony Goldberg. Photo by Jason Lindsey.

Dean's Column

Diverse Disciplines, One Goal: Improving Lives

By Herb Whiteley

The breadth and depth of biomedical discovery at the College of Veterinary Medicine may surprise you.

Our faculty are testing new materials that make bone surgeries safer and more effective. They are delving into the causes of periodic die-offs of lions in the Serengeti. They are identifying the mechanisms by which PCBs damage the nervous system—and reaching out to educate people at risk of ingesting harmful levels of PCBs from fish.

Research at our College crosses species, disciplines, and oceans. Our faculty are internationally recognized. Some have joint appointments in anthropology, bioengineering, psychology, and nutritional sciences, to name a few areas. Their work may focus on a single gene or may encompass entire ecosystems.

The common thread uniting these diverse fields of inquiry is their potential to make life better. At our College, the quest for new knowledge begins with caring, with asking why and how, and with a belief that finding the answers to those questions brings the promise of a better life for animals and people.

This special issue of *Veterinary Report* showcases research initiatives throughout our College. I invite you to learn more about what we do. I hope you'll be inspired to participate in our efforts, whether by referring cases to a clinical trial, collaborating with one of our faculty, or supporting our work through the gift of a chair or fellowship.

I welcome your comments. You can reach me at dean@cvm.uiuc.edu.

"At our College, the quest for new knowledge begins with caring, with asking why and how, and with a belief that finding the answers to those questions brings the promise of a better life for animals and people."

Solving a Viral Mystery: The Persistent Problem of PRRS

By Chris Beuoy

In the late 1980s a disease emerged among U.S. swine herds that wreaked economic havoc on the pork industry by causing abortion and failure to thrive in growing pigs.

The culprit, known initially as the "mystery swine disease," was eventually named Porcine Reproduction and Respiratory Syndrome (PRRS). It is caused by a single-strand RNA virus that is highly infectious and variable.

Over the past 20 years, the PRRS virus has stymied scientists hoping to find a vaccine for what has become the most economically important health problem facing pork producers, accounting for more than $560 million in losses each year.

A June 1 colloquium organized at the College of Veterinary Medicine (see side bar) assessed the prospects for development of an effective PRRS virus vaccine. Experts agreed that while modified-live virus vaccines are effective against reinfection with the same viral strain, the large number of variations—PRRS is more variable than the AIDS virus—has left pork producers without effective control strategies. Indeed, it was concluded that basic questions about the biology of the virus and how it causes disease have gone unanswered.

Two Problems to Solve

Dr. Federico Zuckermann, an immunologist in the Department of Pathobiology, believes he may be close to finding some answers.

"To create an effective vaccine you have to solve two problems," he says. "You have to develop a robust cell line in which to grow the virus and you have to isolate a strain of the virus that will stimulate immunity to many variants."

His laboratory has been successful on both counts.

Until now, the only available cell line that supports growth of the PRRS virus comes from a simian kidney cell line. Because of patent restrictions, one company controls the commercial use of this cell line, which has stifled the development of an effective vaccine against this virus. This imposed limitation has led many researchers to attempt to develop alternative cell lines—a challenge that is a research funding priority for the National Pork Board—but so far there has been no success.

With a Pork Board grant, Dr. Zuckermann developed a cell line in three years with just three attempts.

"We were able to make a cell line that is robust and grows the [PRRS] virus," he acknowledges, but he is very protective of his discovery.

Tom Schaefges

Dr. Federico Zuckermann holds a flask of ZMAC-1. "It's like growing orchids," he says of the delicate cell line he developed to grow the PRRS virus. Dr. Gabriela Calzada-Nova is a member of his lab.

"I'm the only one who touches the cell line. It's like growing orchids, almost. Very difficult. It has to be free of impurities, pathogens—everything. We don't even put in an antibiotic."

In January he applied for a patent for "ZMAC-1," the cell line he developed from a third-generation pig alveolar macrophage cell line. The ZMAC-1 line was started on May 6, 2006, with a few thousand cells and has since produced over a billion cells.

"I'm very confident that it will be robust enough to use for commercial purposes," he says.

Dr. Zuckermann believes he has also mastered the second key need for developing vaccine: finding a strain of the virus that will elicit a broadly protective immune response.

"The beauty of science is if you look you'll find. There is so much to discover. There is no end. That's what is exciting. That's why I do biology and not physics. There is more to discover."

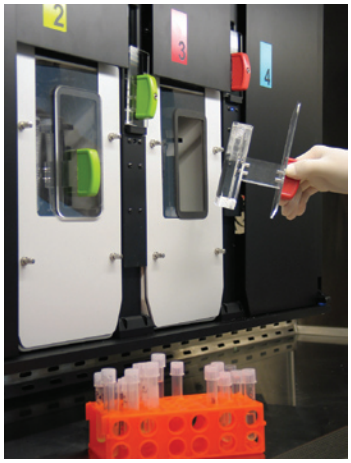
continued on page 2

PRRS, continued

Technological Power

A partnership with iCyt Mission Technology, Inc., a startup company located in the University of Illinois Research Park, has been a major boon to Dr. Zuckermann's research. Through a collaborative agreement, a new Reflection™ cell sorter, which offers multiple highly automated parallel sorting modules, was acquired and will be located in the Pathobiology Department for continued collaboration with iCyt and for the benefit of the research community at the University of Illinois. Dr. Zuckermann's studies give iCyt engineers a very challenging real-world research application to help them validate the equipment and perfect the software.

Observing that "the PRRS virus knocks out the pig's innate immune system" and, as a result, cells from PRRS virus-infected pigs become severely impaired in their ability to produce interferon alpha, Dr. Zuckermann decided to focus his efforts on plasmacytoid dendritic cells (PDCs), a cell population that produces copious amounts of interferon alpha and provides the body's initial protective response to a virus.



courtesy of iCyt

A Reflection™ cell sorter for use by campus will reside in the Department of Pathobiology.

One obstacle to studying PDCs is isolating them: this cell type accounts for only one-half of one percent of the pig blood in which they are found. With iCyt's Reflection™, this infrequent cell population PDCs can be purified into a sample that is more than 90 percent PDCs with greater than 98% efficiency in a few hours.

"The power of the new iCyt machine is that it is inside a biosafety cabinet," says Dr. Zuckermann. "PRRS is a biosecurity level II agent. The Reflection™ provides a sterile and safe environment, with a built-in laminar flow hood. And it can do three times the volume of the cell sorters on campus."

PRRS Research Continuum

- Dr. Zuckermann is one of five pathobiology researchers engaged in an integrated PRRS research effort spanning the molecular biology of the virus, virus-host interactions, and disease epidemiology in swine herds.
- Dr. Dongwan Yoo uses full-length infectious cDNA clones and "reverse genetics" to study the PRRS virus at the molecular level.
- Dr. William Laegreid uses an eco-epidemiologic approach that includes state-of-the-art molecular genomics and population-based studies to examine factors affecting the PRRS virus.
- Dr. Tony Goldberg looks at how the virus evolves within animals and on farms, and how viral evolution interacts with host immunity to influence the course and severity of disease in pigs.
- Dr. Larry Firkins is concerned with best management practices on swine farms and the economic impact of PRRS on Illinois pork producers.

White Paper Identifies Needs in PRRS Vaccine Research

Porcine Reproductive and Respiratory Syndrome (PRRS) is the most significant disease problem facing the swine industry worldwide. In the United States alone, PRRS is estimated to have an economic impact between $560 million and $762 million annually on pork producers. Yet nearly 20 years after PRRS was first identified, there has been little success in developing economical and effective control strategies for this highly variable viral disease.

On June 1 and 2, 2007, researchers at the College of Veterinary Medicine convened a group of 22 national experts in PRRS, virology, immunology, and vaccinology to discuss the state of current knowledge about PRRS vaccination. The group included clinical veterinarians, academic researchers, and vaccine industry scientists.

The resulting white paper represents a significant advance in achieving scientific consensus on the knowledge gaps that must be addressed in order to produce successful vaccination strategies to control the impact of PRRS. If future research proceeds along suggested pathways, the group agreed that effective vaccine strategies could reach the market within the next 5 to 10 years.

Key areas for future research include identifying the mechanisms by which the PRRS virus causes disease and the components of the virus that play a role in inducing protective immunity.

Copies of the white paper are available on the College Web site or by contacting the Department of Pathobiology at 217/333-2449.

Asthma: Cloned Pigs Offer Clues

Using cloned pigs as a model, Dr. Federico Zuckermann has found evidence for the theory that environment plays an important role in an individual's susceptibility to asthma.

Asthma is on the rise in industrialized nations. This chronic allergic disease, in which the immune system overreacts and causes acute respiratory symptoms, afflicts about 20 million Americans and kills about 4,000 each year.

In an experiment done in collaboration with Dr. Larry Schook, animal sciences, Dr. Zuckerman evaluated the variation in cloned pigs' immune response compared with pigs that were not genetically identical. Not surprisingly there was less variation in the cloned pigs.

But further experiments revealed that not all cloned pigs are born equal. A group from one sow exhibited a different immune response, even though they were genetically identical to the pigs from another sow. The only difference between litters was the "environment" of the sow's uterus.

With the help of Dr. Murli Manohar, veterinary biosciences, Dr. Zuckermann developed a way to measure the pigs' lung function to determine the degree of asthmatic response. The team was able to create a pig model for the disease, inducing asthma in more than 80 percent of pigs.

"If we could create a pig model that exhibits food allergy, that would be really useful," says Dr. Zuckermann. "New foods could be scored to evaluate their potential for allergens."

In the debate over whether environment or genetics contributes more to asthma and other allergic diseases, Dr. Zuckermann's findings show that "environment" could relate to maternal environment or to the astoundingly broad world of gut flora.

"The potential impact of the microbial world on the function of the immune system is huge and vastly underappreciated," asserts Dr. Zuckermann. "The main interface is in the gut. There are more bacteria in the gut than there are cells in the body."

Significantly, the environment of the gut can be altered, perhaps in ways that would reduce or eliminate allergic reactions.

"This is the 'hope' area," he says. "The biology of the gut microflora may be controllable. The holistic physiological point of view is the way of the future to cure disease."

"The potential impact of the microbial world on the function of the immune system is huge. There are more bacteria in the gut than there are cells in the body."

Alleviating Bone Cancer Pain May Prove an Alternative to Amputation

Study Illustrates Linkages Between Human and Canine Oncology

By Lisa Xia

Osteosarcoma—the most common primary bone tumor in canines—is almost always fatal and causes excruciating pain as the cancer destroys the afflicted bone, typically in a limb.

Traditional therapy for osteosarcoma includes amputation of the affected limb, coupled with systemic chemotherapy. For dogs that are not good candidates for amputation due to pre-existing health problems such as obesity or osteoarthritis, definitive treatment options are limited. For these non-surgical patients, control of bone cancer pain is paramount and can be effectively achieved with palliative therapies combining radiation therapy to the affected bone with systemic chemotherapy.

Many pet-owners find amputation an undesirable and aggressive surgical procedure. They would prefer to keep the leg on their pets.

Many pet-owners find amputation an undesirable and aggressive surgical procedure. They would prefer to keep the leg on their pets, says Dr. Timothy Fan, an oncologist in the Department of Veterinary Clinical Medicine. Although patients treated with only radiation and chemotherapy demonstrate significant pain alleviation, most dogs will eventually experience progressive bone cancer pain, ultimately resulting in humane euthanasia. That's why finding new ways to manage bone cancer pain in conjunction with other therapies is important.

Dr. Fan is leading a study, along with Drs. Laura Garrett, Louis-Philippe de Lorimier, and Sarah Charney in the oncology section, to determine whether using pamidronate, a potent anti-resorptive agent, in conjunction with radiation and chemotherapy may effectively alleviate bone pain in dogs with osteosarcoma while maintaining or even surpassing the expected survival time associated with conventional treatment.

Novel Treatment Approach

"I think cancer pain is a concept that is only beginning to be realized," Dr. Fan says, adding that in the past, most studies have focused on controlling the cancer but not the pain associated with it.

"What's so novel about this study is that it is a study really looking at cancer pain management in the animal."

Approximately 8,000 dogs in the U.S. are diagnosed with osteosarcoma each year. This cancer occurs almost exclusively in large and giant breed dogs, such as greyhounds, rottweilers, retriever breeds, Irish wolfhounds, and Newfoundlands. The median survival time for dogs treated with amputation and systemic chemotherapy is approximately 1 year, according to Dr. Fan.

The three-year randomized, placebo-controlled, double-blinded study, funded by Morris Animal Foundation, is slated to enroll up to 50 dogs. All patients will receive standard dosages of radiation and chemotherapy to ensure ethical and humane treatment of dogs with osteosarcoma. Patients will be randomized to receive either pamidronate or a placebo saline solution.

Pamidronate, an aminobisphosphonate, is currently used in human patients as a first-line therapy for metastatic carcinomas involving bone. It has shown effectiveness for reducing bone pain associated with tumor-induced pathologic bone resorption.

Tom Schaefges

Dr. Timothy Fan ***(at right)*** **works with Ian Sprandel in Dr. Fan's laboratory in the Veterinary Teaching Hospital.**

"In future studies, as we evaluate novel cancer therapeutics in the pipeline of development, the dog should be considered an accurate comparative model for the study of osteosarcoma and other tumor types shared between dogs and people," Dr. Fan says.

Focus on Quality of Life

Bone destruction, a significant contributor to bone pain, is caused by naturally occurring osteoclasts that—overstimulated by cancer cells—essentially eat away the bone. Aminobisphosphonates directly inhibit osteoclastic activity—and therefore osteoclastic bone resorption—and in doing so, reduce malignant bone pain. *In vitro*, aminobisphosphonates have also shown direct anti-cancer properties, actually killing tumor cells at pharmacologic concentrations which are physiologically achievable, Dr. Fan says.

Throughout the course of the study, dog owners will work with researchers to subjectively evaluate the dogs' level of activity and pain. The observations of pet owners will be coupled with researchers' objective analyses of bone tumor density, changes in bone resorption markers, and a gait analysis test in which a computer assesses how the pet is walking.

If the study shows that dogs can live relatively pain-free without amputation for a duration of time that approaches the survival period offered by amputation (about 10 months), the findings may change how pet owners opt to treat their dogs with osteosarcoma, says Dr. Fan.

"It becomes an attractive alternative treatment option for osteosarcoma patients if we can achieve survival times closer to one year without amputation," says Dr. Fan.

Canine-Human Cancer Connection

While the focus of this study is to optimize the quality of life for cancer-afflicted dogs for as long as possible, the study also demonstrates the biologic similarity between human and canine osteosarcoma. The incidence of osteosarcoma is significantly higher in dogs than in humans, and the fatality rate is much higher as well. Of the small percentage of people who develop osteosarcoma, up to 70 percent will be cured, Dr. Fan said.

In addition, osteosarcoma progresses much more quickly in dogs than in humans, exhibiting the effects of the disease or benefits of treatment within a year compared with about five years in human beings.

Dr. Fan hopes that the similarities between canine and human osteosarcoma demonstrated in this study will also influence the way researchers look to dogs as a subject for later studies concerning human health and medicine.

"In future studies, as we evaluate novel cancer therapeutics in the pipeline of development, the dog should be considered an accurate comparative model for the study of osteosarcoma and other tumor types shared between dogs and people," Dr. Fan says.

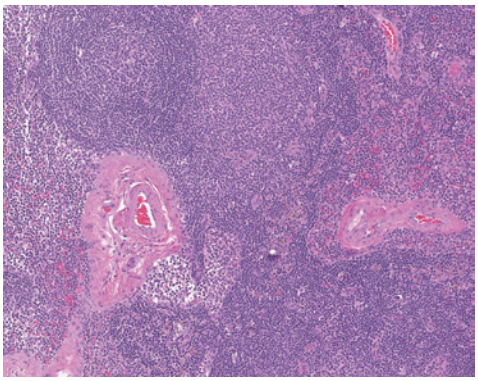
International Experts Bring WHO Standards to Canine Lymphoma Diagnoses

By Lisa Xia

In August, Dr. Victor "Ted" Valli, pathobiology, brought thirteen of North America's best veterinary pathologists to Urbana to examine 300 tissue samples of canine lymphoma collected from across the United States. They sought to identify a spectrum of diseases in lymphoma, a cancer that has traditionally been treated as a single disease in dogs.

Through this meeting and another to be held later this year—both funded in part by grants from the American Kennel Club and the American College of Veterinary Pathologists—25 international experts will eventually examine the lymphoma samples.

The goal: to set international standards for diagnosing canine lymphoma and change the way treatment is administered to afflicted dogs.



Canine lymph node.

Tailored Treatment

Lymphoma, a type of cancer that affects the lymph nodes, liver, and spleen and is among the most common types of cancer affecting dogs, is usually treated with a standard dosage of chemotherapy.

"The problem is that in veterinary oncology, the disease has been treated as generic and in a generic manner," Dr. Valli says. "But some lymphomas are slow-growing and others are violently progressive. The high-grade tumors tend to be undertreated, and for the low-grade tumors, dogs suffer the destruction of normal tissue. Our work has shown that lymphomas in the dog have the same level of variability as they do in people."

Lymphocytes come in two major families that are known as B-cells (because they were first identified as an entity in the lymphoid "Bursa" of birds) and T-cells (because they receive their early training in the thymus gland). In humans, there are 16 different disease subtypes of lymphoma for each of the B-cell and T-cell types, with each varying in aggressiveness and other factors.

Because the genetic make-up in humans and dogs, as well as the cancers that occur in both species, are so similar, Dr. Valli is confident that the specialists will be able to identify similar sub-types of canine lymphomas with a high degree of accuracy.

The second group to review the slide set included *(from left)* **Dr. Jeff Caswell, Ontario Veterinary College, Guelph; Dr. E.J. Ehrhart, Colorado State University, Fort Collins; Dr. Dorothee Bienzle, Ontario Veterinary College, Guelph; Dr. Sally Lester, Central Laboratory for Veterinarians Ltd., Langley, B.C.; and Dr. Ted Valli, University of Illinois, Urbana. Dr. Jose Ramos-Vara, Purdue University, West Lafayette, Ind., was also part of this group.**

The identification of these 16 disease subtypes for B- and T-cells was in large part due to a change, in 1993, in the World Health Organization's method of classifying the different varieties of human cancers. Medical doctors prescribe treatment specific to a particular disease. The August conference tested the viability of the WHO classification system for lymphomas in dogs.

If successful, the project will enable specialized cancer diagnoses so that dogs with different varieties of lymphoma can receive individualized treatment.

"The oncologists are limited in their treatment of lymphoma by the degree of specificity they get in the diagnosis," Dr. Valli says. "If the diseases have this huge variability from very aggressive to very indolent, the disease should direct the treatment."

Worldwide Access

Fifty slides of tissue samples have been digitized and posted in an online database with public access. The database was created in collaboration with Dr. Fred Dee of the College of Medicine at the University of Iowa. These cases include controls for the various stains that permit recognition of the B- and T-cell subtypes under a magnification of up to 400 times. When the study is complete, consensus diagnoses will be added to the database to provide an easily accessible international standard for canine lymphoma identification.

"Now this is neat because a pathologist anywhere can ask how his case compares to another one and bring up this database," Dr. Valli says.

As the treatments for the dogs change in accordance to the type of lymphoma identified, Dr. Valli will track how the variation in treatment will affect the dog's survival and life quality. Eventually, Dr. Valli hopes to publish how treatment affected the outcomes for all animals involved in this study, which received additional funding from Idexx Laboratories, Fort Dodge Animal Health Products, Dr. Sally Lester, and a private veterinary pathology service.

For now, he is certain of the project's success and its potential to instigate change.

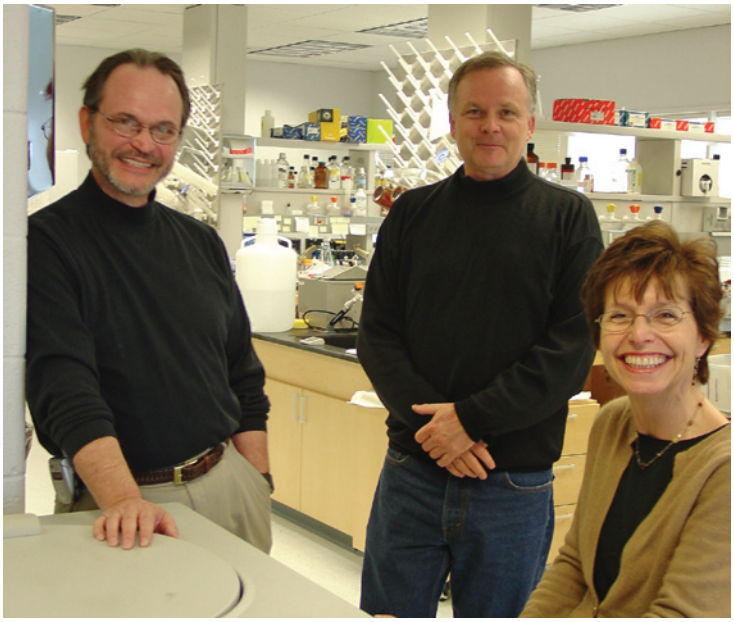
"We feel that this will tremendously benefit dogs and their owners and improve our ability to understand these diseases," he says.

Missing Transcription Factor Leads to Insights into Stem Cell Biology

By Lisa Xia

Three years ago, a team in the pathology and immunology department at the Washington University School of Medicine in St. Louis used knockout technology to remove a transcription factor from laboratory mice. The team expected to see mice with immunological problems. Instead, what resulted from the experiment were healthy mice that were curiously sterile.

By word of mouth through graduate students, slides of the abnormal sperm cells found their way under the microscope of Dr. Rex Hess, a specialist in male reproductive and stem cell biology at the College of Veterinary Medicine. The project, which has made significant advancements in the understanding of how stem cells in the testes divide and differentiate, has since been reported in a letter published in the journal *Nature*. The mice and the work are now fully under the direction of Dr. Hess, Dr. Marie-Claude Hoffman, and Dr. Paul Cooke in the Department of Veterinary Biosciences.



Stem cells research in the Department of Biosciences holds potential for applications in furthering the understanding of testicular cancer and treating sterility. Drs. Rex Hess, Paul Cooke, and Marie-Claude Hoffman collaborate on this work.

For Dr. Hess, there is a personal motivation that inspires his interest in stem cell research. He believes that stem cells have the potential to cure diseases such as multiple sclerosis, a disease that afflicts his wife.

Current stem cell controversy arises primarily from the use of embryonic stem cells. However, researchers have recently found evidence that stem cells may exist in nearly all adult organs. These adult stem cells are more specialized and organ-specific than are embryonic stem cells.

Research suggests that only stem cells may create new organ cells, Dr. Hess said. For example, normal liver cells that die over time may be replaced only by stem cells, either from liver stem cells or from other stem cells that become differentiated.

Asymmetric Cell Division

In the normal mouse testis, the control model for this project, a spermatogonial cell that reproduces—a process called mitosis—duplicates asymmetrically, forming one differentiated cell that would eventually become a sperm and one new stem cell.

However, in mice that have had the transcription factor ERM (an Ets-related molecule; Etv-5) removed, only the first wave of spermatogenesis, or sperm creation, occurs .

Transcription factors are proteins that facilitate specific gene activity and work to increase synthesis of factors that regulate cell physiology, including mitosis and differentiation.

At puberty, when sperm production becomes important, all stem cells in ERM knockout mice differentiate and become sperm instead of asymmetrically dividing to replace themselves. With no stem cells left to create more sperm, these knockout mice become sterile within four to five weeks of birth.

Although earlier research indicated that in normal mice, ERM started being expressed at puberty (when ERM knockout mice began showing abnormalities), Dr. Hess's team has recently found that ERM is expressed as early as four days after birth, indicating that there are more factors affecting what signals cause stem cells to differentiate.

Far-reaching Applications

Dr. Hess believes that this research has potentially far-reaching applications, including a better understanding of testicular cancer, creating male contraceptives, and treatment for sterility. For example, other research has shown that sterile mice that were implanted with cell cultures of sperm stem cells regained their ability to reproduce.

Sperm stem cells are particularly interesting, said Dr. Hess, because they are very similar to the embryonic stem cells but do not carry the same risks associated with embryonic stem cells. Because they are so undifferentiated, embryonic stem cells transplanted to various organs in research studies have been shown to reproduce uncontrollably and cause cancer-like growth.

A recently published study showed that certain bone marrow stem cells implanted into the testes of mice were able to differentiate into sperm cell lineages, given that the testicular environments were favorable. Dr. Hess believes there should be a similar application with sperm stem cells, although the impact could be greater given the sheer number of sperm that are produced.

"For each heartbeat, a male produces 1300 sperm," Dr. Hess said. "That's what makes sperm stem cells so excellent to study."

Keeping Microbes Out of Water Supplies, the Natural Way

By Lisa Xia

In 1993, cryptosporidium-contaminated water infected more than 400,000 people in Milwaukee. The infective oocysts of this protozoan parasite created the largest outbreak of waterborne disease in United States history, killing over 100 people and giving hundreds of thousands of others severe diarrhea.

Although outbreaks of this large scale are rare, cryptosporidium remains one of the leading causes of water contamination in America—a problem that Dr. Mark Kuhlenschmidt, professor in pathobiology, is trying to control.

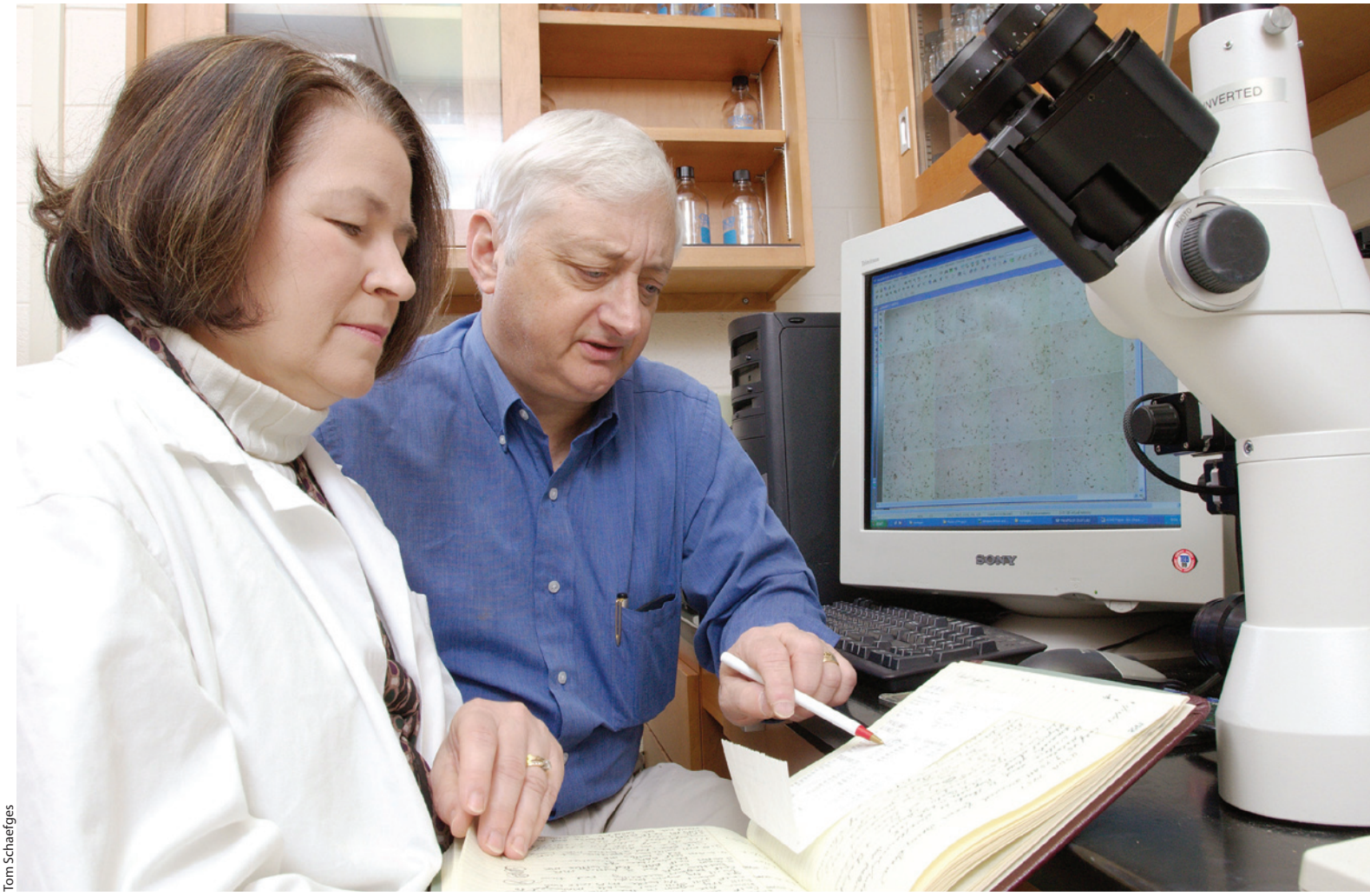
Dr. Kuhlenschmidt is amid a three-year, USDA-funded study determining best management practices for farms and other animal facilities to contain runoff contaminated with cryptosporidium or rotavirus. His co-investigators are Dr. Prasanta Kalita, professor in hydrology in the Department of Agricultural and Biological Engineering, and Dr. Theresa Banet Kuhlenschmidt, research scientist, and Paul Davison, graduate student, both of the Department of Pathobiology.

Their hypothesis for the most efficient way to control this type of water pollution? A little spin on the traditional vegetative filter strip.

Microbial Runoff

Since the passage of the EPA's Clean Water Act in 1972, farms—among other facilities—have been mandated to control nutrient runoff. The two traditional mechanisms used for containing runoff are lagoons and vegetative filter strips, also called buffer strips, which are plots of land

Dr. Theresa Banet Kuhlenschmidt confers with her research partner and husband, Dr. Mark Kuhlenschmidt.



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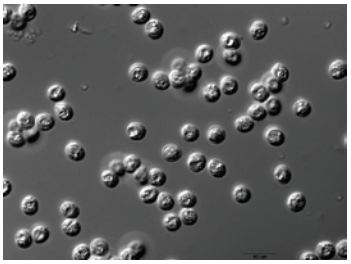


Top: Oocysts of *Cryptosporidium parvum* magnified 1,000 times. Middle and bottom: A scale model of a filter strip used in research at the agricultural engineering building.

over which runoff is directed. The buffer strip, a combination of soil and vegetation (usually grass), reduces runoff flow which results in pathogens penetrating into the soil and binding to the vegetation roots and soil particles, effectively blocking them from entering the waterways.

"Buffer strips have been used for a long time, but there are almost no data showing that they work for pathogens like protozoan parasites or viruses," Dr. Kuhlenschmidt says.

Although the EPA has never written any similar legislation to specifically control microbial runoff, they have recently revised the Clean Water Act to include the regulation of CAFOs (concentrated animal feed operations) in an effort to reduce the amount of agricultural animal wastes entering the nation's waters. Dr. Kuhlenschmidt believes additional legal statutes may be created as concern grows over microbial contamination of our environment and water resources.

"I think the Milwaukee outbreak alerted people to the potential for contamination in the waterways and the need to control environmental runoff," he says.

Following the outbreak, the USDA's National Research Initiative began sponsoring research to examine whether buffer strips could also contain infectious agents.

A Natural Solution

And, so far, Dr. Kuhlenschmidt's research indicates that buffer strips can be extremely effective in that role. In addition, because the strips are made wholly of natural components, the land can be used efficiently if grass grown in the strip can be fed to cattle.

"A natural solution, such as a buffer strip, that stops overland transport of microbial pathogens and can be harvested, would be the easiest, most natural, cost-effective way to solve this problem," Dr. Kuhlenschmidt says. "It's an alternative to mandating some other kind of large lagoon or treatment of the soil, or letting it lay fallow and not using it."

This new study will apply Dr. Kuhlenschmidt's past studies on adhesion properties of rotaviruses and cryptosporidium in determining how these microbes bind to grass and soil components in a vegetative filter strip. By examining the samples taken by wells in the field, he and his team will determine what factors most affect the efficacy of a buffer strip and evaluate the overall effectiveness of the project.

Research will take place on three scales: in the lab, on two small University-owned plots, and on one or two mid-sized farms.

Older studies indicate that cryptosporidium oocysts most readily bind to the clay in soil, while rainfall and the land's slope most impact the strip's efficiency, Dr. Kuhlenschmidt says. For example, if the slope is too steep, the runoff passes over the buffer strip too quickly to contain the microbes. Questions he hopes to answer in this study involve what soil and vegetation types are best for containing the microbes, whether the buffer strip can be overloaded with microbes to a failing point, and how long cryptosporidium must stay in a filter strip before it will die.

His studies have used *Cryptosporidium parvum*, the cattle- and human-infecting strain commonly found on farms. Although *C. parvum* is not usually the strain responsible for most human disease outbreaks, such as those seen in swimming pools and water parks (10 of 14 North American outbreaks have been caused by *C. hominis*), each fall, *C. parvum* usually affects 10 percent to 20 percent of campus dairy cattle, and occasionally veterinary students who care for the cattle fall ill.

And, it takes very few oocysts to create an outbreak.

"It only takes 132 oocysts to infect you and me," Dr. Kuhlenschmidt says. "A single infected calf can release 10^{11} oocysts. That's enough oocysts to infect everybody in the U.S. and a few other countries, theoretically."

Economically Efficient

Dr. Kuhlenschmidt estimates the cost of building and installing a filter strip into a medium-sized farm—like the southern Illinois farm that is part of their grant—falls between $250,000 and $500,000. Even so, he says, filter strips are probably the most economically efficient solution to the polluted runoff problem.

After doing his post-graduate studies on cell adhesion mechanisms, Dr. Kuhlenschmidt found opportunity to apply his knowledge to a new project that he cared deeply about—protecting the world's water supplies. He hopes that his work can reduce contamination in the waterways and prevent the need for additional government-issued statutes to contain microbial pollution that can threaten the existence of the small to medium-sized animal farms.

"It's very interesting work because there's probably nothing more valuable to me than protecting our food supply and particularly, our water supply," Dr. Kuhlenschmidt says. "Ideally, our research will help provide safe water for people to drink while maintaining animal agriculture."

College Represented in National Veterinary Posts

Dr. Herbert Whiteley, dean of the College, and Dr. Elysia Schaefer, equine surgery resident, were elected to leadership positions in the American Veterinary Medical Association in July.

Dean Whiteley was elected to a six-year term representing veterinary medical research on the AVMA Council on Education.

Dr. Schaefer was elected to an unexpired term (ending in 2010) representing recent graduates on the Council on Veterinary Service. Dr. Schaefer had served as the president of the Student American Veterinary Medical Association (SAVMA) in 2004-05.

The current SAVMA Executive Committee includes two Illinois veterinary students: Emily Eaton, president-elect, and Rachel Shaff, secretary.

Students Take Honors at National Conference on Reproduction

Three graduate students from the laboratory of Dr. Humphrey Hung-Chang Yao, veterinary biosciences, were selected from more than 240 student competitors to receive awards for research presented at the 40th Annual Meeting of the Society for the Study of Reproduction, held in San Antonio, Texas, in July.

Debra Domal

Ivraym Barsoum, Denise Archambeault, and Chia-Feng Liu in the Yao laboratory.

Ivraym Barsoum won the trainee research award in the poster presentation category for "Ectopic activation of the hedgehog pathway induces appearance of Leydig-like cells in fetal ovaries."

Denise Archambeault placed second in the oral presentation category for "Inhibin beta a and hedgehog: a novel regulatory loop in fetal testis cord development." Chia-Feng Liu placed fourth in the oral presentation category for "The role of beta-catenin in development of the fetal ovary."

The Department of Veterinary Biosciences is home to eight faculty members who are affiliated with the University of Illinois Reproductive Biology Training Program, which engages in a broad scope of research on female and male reproductive biology at the organism, tissue, cell, and molecular levels.

The Society for the Study of Reproduction, founded at the University of Illinois in 1967, is the leading scientific society for reproductive biology in the world.

$3 Million Grant Furthers Study of Risk Factors for Hot Flashes

With the help of a five-year, $3 million grant from the National Institute on Aging, a professor at the University of Illinois College of Veterinary Medicine will begin to examine why obesity is associated with increased risk of hot flashes in mid-life women.

Earlier this year, Dr. Jodi Flaws, veterinary biosciences, found that obese women have lower levels of estrogen.

Her new study, entitled "Risk Factors for Hot Flashes in Mid-Life Women," will test the hypothesis that obesity is associated with hot flashes through mechanisms that involve ovarian failure, altered sex steroid hormone levels, and selected genetic polymorphisms.

Dr. Flaws and her colleagues at Johns Hopkins University will recruit obese and non-obese perimenopausal women aged 45 to 54 and will follow them for four years to determine whether differences in hormones or genetics increase risk of hot flashes.

L. Brian Stauffer

Dr. Jodi Flaws

Pathology Service Supports Animal Research

As biomedical research has expanded at the University of Illinois, so has the need for veterinary pathologists to support researchers.

Tom Schaefges

Dr. Susan Ball-Kell

It is a need that Dr. Susan Ball-Kell, section head for the Program in Comparative Pathology of Laboratory Animals, is trying to fill.

The new program, nicknamed "LAPP" for lab animal pathology program, was launched by the Veterinary Diagnostic Laboratory last year to provide a tissue-sample analysis service to biomedical researchers at the University of Illinois.

Dr. Ball-Kell, a clinical associate professor, expects her program to grow. LAPP currently supports the University of Illinois campuses in Springfield, Urbana, and Chicago. On the Urbana campus nearly three dozen departments use lab animals, according to Dr. Randall Peper, associate director of the Department of Animal Resources.

College Moves Ahead with Center in Chicago

The Illinois Board of Higher Education recently gave the College the OK to use the name the "University of Illinois Chicago Center for Veterinary Medicine" for its new Chicago-based initiative.

This new center, located at 2242 West Harrison, in the medical district just south of the Loop, will initially offer small animal primary care services, engaging students in the clinical and management aspects of the practice. Ultimately this venture is expected to augment the specialty caseload at the Veterinary Teaching Hospital in Urbana and help the College attract faculty, recruit students from underrepresented groups, collaborate with biomedical researchers in Chicago, and connect with new donors.

Summer Program, continued from back page

Ga. Falendyz screened the samples Czekala had collected for antibodies to orthopoxviruses using an ELISA-based assay. She also extracted DNA from skin samples containing suspicious lesions and tested them for orthopox genomic material using real-time PCR.

The two came face to face only twice: once in early August at the National Veterinary Student Symposium, held in Washington, D.C., and again in mid August in Urbana at the poster session.

Despite the logistical challenges of international collaboration, Czekala and Falendyz took first place for their co-authored poster.

Czekala and Falendyz's work was part of an ongoing monkeypox study at the University of Illinois Earth and Society Initiative. Monkeypox virus is a serious threat to human health in Africa, but very little is known about the virus or its natural host. Dr. Tom Gillespie, assistant professor of pathobiology, and Dr. Joanna Shisler, assistant professor of microbiology, served as mentors on the project.

Dr. Gillespie sees the program's value in its potential to expand student's thinking about research: "Our work in Uganda challenges our mentees to think broadly. They are exposed to a new culture, a new set of problems, and given an opportunity to address these challenges head on within the context of research that builds on their specific training in veterinary medicine. It's a very rewarding process."

The Summer Training Program is run by the Center for Zoonoses Research and co-sponsored by Merck-Merial, the National Institute of Health National Center for Research Resources, and the College of Veterinary Medicine.

Projects from 2007 Summer Training Program

- **Effects of Exposure to the Herbicides Atrazine and s-Metolachlor on *Ribeiroia ondatatrae* Infections of Bullfrog (*Rana catesbeiana*) Tadpoles**
  Ashley Elzerman, Class of 2009
  Mentor: Dr. Val Beasley
- **Effects of Forest Fragmentation and Domestic Livestock Interaction on the Transmission of the Water-borne Microbes *Giardia* spp. and *Cryptosporidium* spp. Between Non-human Primates and Livestock in Kibale National Park, Uganda**
  Annie Lo, Class of 2009
  Mentors: Dr. Tony Goldberg, Dr. Tom Gillespie
- **Gastrointestinal *Salmonella* Diversity in Galapagos Marine Iguanas**
  Emily Wheeler, Class of 2008
  Mentor: Dr. Roderick Mackie
- **Identification of Clostridial Isolates Responsible for Suspected Botulism Outbreak in Horses**
  Jennifer Reinhart, Class of 2010
  Dusty Sachen, Class of 2010
  Mentor: Dr. Brenda Wilson
- **Molecular Phylogenetic Analysis of *Candida albicans* Isolates from Humans and Non-Migratory Wildlife in Central Illinois**
  Lauren Wrobel, Class of 2009
  Mentor: Dr. Lois Hoyer
- **Parasitic Infections of Non-human Primates in Fragmented and Undisturbed Forests in Western Uganda**
  Martha Low, Class of 2009
  Mentors: Dr. Tony Goldberg, Dr. Tom Gillespie
- **Potential Monkeypox Reservoir in Uganda**
  Anna Czekala, Class of 2009
  Elizabeth Falendysz, School of Veterinary Medicine, University of Wisconsin
  Mentors: Dr. Tom Gillespie, Dr. Joanna Shisler
- **SodA as a Virulence Factor in *Streptococcus equi* and *Streptococcus zooepidemicus* Infections**
  Lisa Lukas, Class of 2009
  Mentor: Dr. Carol Maddox
- **The Virulence Role of *Pseudomonas aeruginosa* pyocyanin in Chronic Suppurative Otitis Media**
  Elisabeth Peters, Class of 2009
  Mentor: Dr. Gee Lau

Discoveries in the News

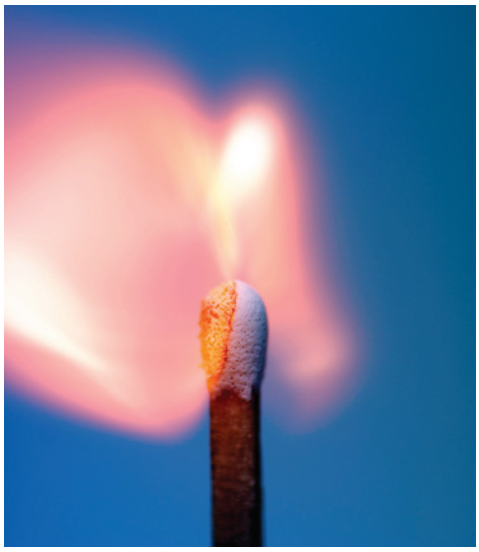
Excerpted from news releases by Diana Yates, Life Sciences Editor, in the News Bureau at the University of Illinois at Urbana-Champaign. The entire articles are available online.

Hot Flashes: Studies Explore the Role of Genes, Obesity, and Alcohol

More than 40 million women a year experience hot flashes: unpredictable, sometimes disruptive, periods of intense heat in the upper torso, neck, and face. Yet very little research has focused on the underlying causes of hot flashes.

Three recent studies explored the role of genes, obesity, and alcohol consumption in contributing to—or lessening—the intensity and frequency of hot flashes in midlife women. The studies were part of a five-year research effort led by Dr. Jodi Flaws, veterinary biosciences, and colleagues at the University of Maryland, Mercy Medical Center in Baltimore, and the School of Medicine at Johns Hopkins University.

The paper published in *Maturitas* reported on a cross-sectional study involving 639 women aged 45 to 54. The researchers looked at individual differences in the genes that code for various hormones. Their findings confirmed those from an earlier study by the same team that there is evidence of a genetic basis for hot flashes.



In another paper, published in the journal *Climacteric*, the researchers used the same data to analyze the link between obesity and hot flashes. The researchers found a significant link between obesity and higher levels of testosterone as well as lower total estradiol, estrone, progesterone and sex hormone binding globulin. The finding on estradiol was surprising because adipose tissue produces and stores estradiol, the major estrogen in humans. Most people had assumed that obese women would have higher circulating estrogen levels because of this, according to Dr. Flaws.

A third analysis, published in the journal *Fertility and Sterility*, examined the influence of alcohol consumption on hot flashes in midlife women. Although an earlier study showed that moderate alcohol consumption actually reduced the severity of hot flashes by 25 percent, this study failed to turn up any significant hormonal differences between the alcohol users and the women who never used alcohol.

More at **www.news.uiuc.edu/news/07/0424flashes.html**

E. coli Bacteria Migrating Between Humans, Chimps in Ugandan Park

Dr. Tony Goldberg, pathobiology, has found that people employed in chimpanzee-focused research and tourism in Kibale National Park in western Uganda are exchanging gastrointestinal bacteria—specifically *Escherichia coli*—with local chimpanzee populations. And

some of the *E. coli* strains migrating to chimps are resistant to antibiotics used by humans in Uganda.

Other studies have found bacterial exchanges between humans and non-human primates—particularly in areas where the animals are known to frequent garbage piles near human settlements. But this was the first study to document the exchange of *E. coli* between humans and chimps in a protected wildlife area. It was also the first to find antibiotic-resistant strains in chimpanzees in Africa.

"Antibiotic resistance has traditionally been associated with two factors: indiscriminate and over-prescription of antibiotics by physicians in the developed world and the inclusion of antibiotics in animal feed in the developed world," says Dr. Goldberg. The new findings show that over-the-counter sales of antibiotics for human consumption can also have an impact on wildlife.

This study, which was funded by the Morris Animal Foundation, appeared in the April 2007 issue of *Biological Conservation*. The research team included researchers from Makerere University in Kampala, Uganda, and McGill University in Montreal.

More at **www.news.uiuc.edu/news/07/0222chimps.html**

Researchers Find Gene That Spurs Development of the Epididymis

Human sperm cells travel up to 6 meters in their transit from testes to penis, and most of that journey occurs in the epididymis, a tightly coiled tube that primes the cells for their ultimate task: fertilization.

In a paper published in the *Proceedings of the National Academy of Sciences*, Dr. Humphrey Hung-Chang Yao, veterinary biosciences, reported discovery of a gene—and related mechanism—essential to the embryonic development of the epididymis.

Investigating an anomalous specimen noticed by graduate student Jessica Tomaszewski, Dr. Yao's team discovered that inhibin beta A spurs activity in the cells that form the walls of epididymal tube. Further study showed that a lack of inhibin beta A led to stasis in these cells. Without it, the cells divided too slowly to adequately lengthen the tube.

This research adds to the evidence that while testosterone is the master switch that triggers the development of male reproductive structures, it doesn't work alone, Dr. Yao says.

"The identification of inhibin beta A in the development of the epididymis is important for understanding the basic biology of male sexual development," says Dr. Yao. "But it also provides new insight into male infertility."

Graduate students Avenel Joseph and Denise Archambeault contributed to this study. The work was supported in part by the National Institutes of Health.

More at **www.news.uiuc.edu/news/07/0627epididymis.html**

Insights into Osteosarcoma in Cats and Dogs May Improve Palliative Care

A molecular pathway known to have a role in the progression of bone cancer in humans is also critical to the pathology of skeletal tumors in dogs and cats, according to research by Dr. Anne Barger, pathobiology, and Dr. Tim Fan, veterinary clinical medicine. Their work could lead to advances in the palliative care of companion animals afflicted with osteosarcoma.

The research examined the homeostatic role of an enzyme, receptor activator of nuclear factor kappa-B (known as RANK), and two key modulators of its activity: RANK ligand (RANK-L) and osteoprotegrin (OPG). In health, RANK, RANK-L, and OPG together keep the continual process of bone growth and resorption in balance.

The researchers are the first to verify that the expression of this protein, which worsens the effects of bone cancer in humans, also occurs in cats and dogs with skeletal tumors. Their study appeared in the *Journal of Veterinary Internal Medicine*.

Eventual therapeutic interventions may make use of OPG or other RANK-L inhibitors to slow the process of bone destruction in skeletal tumors in cats and dogs. Although not a cure, this could reduce the pain and other complications associated with bone cancer. Such therapies have proven effective at reducing pathologic bone loss in human bone cancer patients.

"Owners often make decisions to euthanize based on pain," says Dr. Barger. "If we can lessen the pain associated with the tumor, we can improve the quality of life and the lifespan."

More at **www.news.uiuc.edu/news/07/0301bones.html**

Research Projects Funded Between April 1, 2006, and March 31, 2007

Beasley V., Nathan Cummings Foundation, $40,000, Envirovet 2006

Beasley V., World Wildlife Fund, $10,000, Envirovet 2006

Byron C., USDA/Animal Health & Disease, $19,195, Osteoclast Regulators RANKL and OPG in Equine Articular Cells

Byron J., Wayne D. & Josephine Spangler Funds, $5,960, Correlation of Disease Staging of Canine Blastomycosis and Prognosis in Treated Dogs

Clark-Price S., Companion Animal Memorial Funds, $6,000, The Effects of Intraoperative Application of Intraarticular Morphine on Total Cell Count, Cell Differential, and Protein Concentration of Synovial Fluid in Horses Undergoing Arthroscopy for Osteochondrosis.

Flaws J., NIH, $325,590, The Role of Aryl Hydrocarbon Receptor in the Ovary

Goldberg T., Illinois Department of Agriculture Cattle and Swine Disease Funds, $11,200, PRRS Virus Epidemiological Control through Whole Genome Viral Sequencing

Goldberg T., Lindbergh, $10,160, Enhancing the Compatibility of Marine Protected Areas and Sustainable Recreational Fisheries

Goldberg T., University of Minnesota, $75,000, Viral Genetic Variation and Cross-Protective Immunity to PRRS Virus: An Integrated Experimental and Epidemiological Approach

Goldberg T., USDA/Hatch, $13,245, PRRS Virus Epidemiological Control through Whole Genome Viral Sequencing

Hahn N., USDA/APHIS, $91,609, Markers for Transmission of Pseudorabies from Feral Swine

Ham K., Companion Animal Memorial Funds, $3,881, Validation and Intra-Operative Use of a Rapid Parathyroid Hormone Assay to Measure Parathyroid Hormone in Dogs with Naturally Occurring Primary Hyperparathyroidism

Hart K., Illinois Department of Agriculture Cattle and Swine Disease Funds, $25,000, The Effect of Non-Medicated Food on Ourdoor Nursery Pig Health and Performance

Haschek-Hock W., University of Iowa, $16,030, PCBs Metabolism Genotoxicity and Gene Expression In Vivo

Haschek-Hock W., USDA, $5,000, Evaluation of a Potential for In Vivo Toxicity of Pyrrocidene A in Mice

Johnson Y., USDA/Animal Health & Disease, $19,476, Transmission of Methicillin-Resistant *Staphylococci* between Horses and Humans

Johnson Y., USDA/Hatch, $16,851, Enhancing Food Safety for Retail Meat and Poultry Products

Kitron U., University of California-Davis, $80,845, Measuring Entomological Risk for Dengue

Kitron U., Yale University School of Medicine, $97,339, Spatial Risk Model for *Ixodes scapularis*-borne Borrelia

Kuhlenschmidt M., USDA/Animal Health & Disease, $19,500, Mechanism of *Crytoposoridium parvum* Sporozoite-Host Cell Invasion

Kuhlenschmidt M., USDA/CSREES, $400,000, Control of Cryptosporidium and Rotavirus Contamination in Agricultural Watersheds

Maddox C., USDA/Hatch, $21,784, Common Virulence Attributes of Lancefield Group C *Streptococci*

Miller G., American Association for the Advancement of Sciences, $84,559, AAAS Science & Technology Policy Fellowship

Morin D., Illinois Department of Agriculture Cattle and Swine Disease Funds, $17,200, Influence of Milking Frequency on Antibiotic Concentrations in the Milk of Dairy Cows Treated with an Intramammary Antibiotic

Sable H., National Institutes of Health (NIH), $89,806, Assessment of Psychostimulant Addiction Risk Following Developmental PCB Exposure

Schantz S., NIH, $307,344, PCBSs, PBDEs Hearing Loss & Attention/Impulsivity: Mechanistic Studies in Animals

Stewart A., American Quarter Horse, $32,495, Growth Factor Enhancement of Mesenchymal Stem Cell-Based Therapies to Promote Tendon Healing

Stewart A., Grayson Jockey, $9,300, Growth Factor Enhanced Progenitor Cells for Tendon Healing

Stewart A., USDA/Animal Health & Disease, $18,944, Co-treatment with Hylartin-V and Triamcinolone on Inflamed Chondrocytes

Stewart M., American Society for Bone & Mineral Research, $38,500, Assessment of ADAMTS Expression and Activity by Chondrocytes

Stewart M., Illinois Regenerative Medicine Institute, $250,000, Restoring Mesenchymal Cell Plasticity for Musculoskeletal Tissue Regeneration

Stewart M., USDA/Animal Health & Disease, $19,500, Phenotypic Suitability of Intrasynovial Stem Cells for Articular Cartilage Repair

Stewart M., USDA/Hatch, $23,000, ADMTS Aggrecanase Expression and Activity in Equine Osteoarthritis

Terio K., University of California-Davis, $12,096, Investigating Health Threats to Conserve Endangered African Wild Dogs

Urbasic A., Companion Animal Memorial Funds, $1,500, Investigation of Myxoma Virus as an Oncolytic Agent

Urbasic A., Wayne D. & Josephine Spangler Funds, $5,500, Investigation of Myxoma Virus as an Oncolytic Agent

Valli V., American Kennel Club Canine Health Foundation, $42,128, A Collaborative Study by Veterinary Oncologists, Pathologist and Diagnostic Laboratories to Enhance the Detection, Diagnosis and Treatment of Canine Lymphoma

Yoo D., National Pork Board, $98,876, Development of Stable Cell Lines Permissive for PRRSV Replication & Production

Yoo D., Pfizer Animal Health, $116,546, PRRS Virus Interaction with CD 163

Zuckermann F., National Pork Board, $109,520, Immunogenicity and Potency of PRRS MLV Vaccines with and without IFN-Alpha Suppressing Capacity

Zuckermann F., University of Minnesota, $190,716, Integrated Control and Elimination of Porcine Reproductive and Respiratory Syndrome Virus (PPRSV) in the U.S.

Bob Meyers

Dr. Thomas Graves

By Marie Labak

Quite probably the only person at the College to have performed solo at Lincoln Center, Dr. Thomas Graves brings tremendous creativity to his varied role as faculty member.

Now an associate professor and head of the Small Animal Medicine section in our Veterinary Teaching Hospital, Dr. Graves had wanted to be a veterinarian since he was five years old. Instead of pursuing that dream initially, Dr. Graves studied piano performance at Arizona State and spent several years as a professional pianist in New York City.

Fortunately, the man who is considered by some to be one of the top endocrine experts anywhere found his way to a veterinary career. He got involved in research at the Animal Medical Center and earned a veterinary degree at Cornell University. After completing an internship at Ohio State and an internal medicine residency at Michigan State, Dr. Graves entered a PhD program at the University of Rochester with support from an NIH grant.

His doctoral work investigated calcium signaling, and he's focused recent work on calcium signals that underlie insulin secretion mechanisms.

"I am not a typical scientist in any way. I have tremendous math anxiety, and I can't figure out how to set the clock on my microwave. I'm really more of a right-brained person."

Like his career path, Dr. Graves' approach to research questions is unusual.

"I am not a typical scientist in any way," he says. "I have tremendous math anxiety, and I can't figure out how to set the clock on my microwave. I'm really more of a right-brained person."

But right-brained creativity may be what makes Dr. Graves so prolific and his research so varied.

Dr. Graves is constantly thinking of new questions to pursue. "I'm always going off in different directions," he notes. "I prefer my research to be based on something that is a little new to me, something I don't know everything about, and of course something that is relevant to and has fruitful possibilities for helping my patients and teaching my students."

His curiosity has led him and his students to seek out better ways to measure glomerular filtration rate in cats, treatments for renal secondary hyperparathyroidism in cats, and diagnostic methods for early detection of feline diabetes.

Dr. Graves is currently involved in developing some innovative new treatments for diabetes, both for cats and for people.

Along with his own work on diabetes, Dr. Graves is also partnering with Dr. Kelly Swanson in Animal Sciences at Illinois to study effects of diet on the development of glucose intolerance and obesity in cats.

In collaboration with Dr. Marcella Ridgway and Dr. Julie Byron in the Department of Veterinary Clinical Medicine, Dr. Graves is working on new ways to assess platelet function using fluorescence microscopy, on novel diagnostic tests for adrenal gland disease using immunocytochemistry, and on mining the important clinical gems from the Veterinary Teaching Hospital's uniquely large caseload of dogs with blastomycosis.

Dr. Graves is also returning to his early roots in feline hyperthyroidism research by working to elucidate the intracellular signaling pathways of the feline thyrotropin receptor.

The questions never stop, and Dr. Graves brings his inquisitive nature to his teaching as well. He teaches courses that span all four years of the veterinary curriculum, from first-year clinical orientation and physiology to fourth-year internal medicine clinical rotations.

"I want to encourage my students to question things. I like people to keep in mind that much of what they know isn't true."

Even though he may be internationally renowned for his research, passing on this scholarly skepticism to his students may be one of the more rewarding aspects of Dr. Graves' work.

"I used to feel that I was a clinician first and a scientist second, but now I feel I'm a teacher first, then a clinician, then a researcher," he says. "I love teaching—any course they'll let me teach, I'll teach."

Suzanne Berry

Assistant Professor, Veterinary Biosciences

- BS, University of Illinois at Urbana-Champaign, 1995
- PhD, University of Wisconsin at Madison, 2001

Research Interests: Utilizing stem cells to repair damage and prevent disease progression in murine models for human muscular dystrophies.

Dr. Berry's doctoral studies in human oncology focused on the role of DNA mismatch repair proteins in processing drugs used to radiosensitize cancer cells. Her postdoctoral research in Holland continued her research on DNA repair and cancer. Dr. Berry has spent the past 3 years at the University's Urbana campus completing post-doctoral research, which entailed isolating stem cells from mice, characterizing them, and utilizing them to treat muscle disease in a murine model for Duchenne muscular dystrophy.

"I'm very happy to be at the College of Veterinary Medicine," says Dr. Berry. "My colleagues here are excellent scientists, and have also proven to be friendly and gracious."

Natalie Coffer

Visiting Clinical Instructor, Veterinary Clinical Medicine

* BVetMed, Royal Veterinary College, University of London

Research Interests: Internal medicine issues, parasitism, and herd health for goats, sheep, and beef and dairy cattle and equine medicine.

Dr. Coffer received her veterinary medical degree from the Royal Veterinary College in London, England, and completed an internship in Field Services, Theriogenology and Production at the University of Georgia and an internship at the Royal College of Veterinary Surgeons in London. She then completed a combined equine and farm animal residency in large animal internal medicine at the University of Tennessee. She enjoys working on medicine cases of all large animal species and has a particular interest in camelid and small ruminant medicine.

Levent Dirikolu

Assistant Professor, Veterinary Biosciences

- DVM, Ankara University, Turkey, 1992
- MVSc, University of Kentucky, 1997
- PhD, University of Kentucky, 2001

Research Interests: Pharmacokinetics of highly orally bioavailable salt formulations of triazine-based antiprotozoal agents, including diclazuril and toltrazuril sulfone for the treatment and prophylaxis of Equine Protozoal Myeloencephalitis in horses; development and validation of analytical methods for the detection and quantification of therapeutic agents administered to racehorses and interpretation of the pharmacological significance of these analytical results.

Dr. Dirikolu was involved in the development of the first FDA-approved therapeutic medications for the treatment and prophylaxis of Equine Protozoal Myeloencephalitis. For the past four years Dr. Dirikolu has worked at Tuskegee University in Alabama as an assistant professor in veterinary pharmacology. While at Tuskegee he was honored with the Faculty Performance award, the Norden Distinguished Teacher of the Year award, and the Pfizer Animal Health Research Excellence Award.

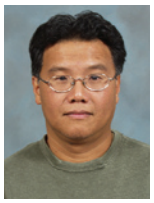
Marie-Claude Hofmann

Associate Professor, Veterinary Biosciences

- BS, University of Lausanne, Switzerland, 1977
- PhD, University of Lausanne, Switzerland, 1988

Research Interests: Unraveling the molecular mechanisms of self-renewal and differentiation of spermatogonial stem cells in the mouse, and the disruption of these mechanisms by toxicants.

Dr. Marie-Claude Hofmann earned a PhD degree in cell biology and completed a 2-year postdoctoral appointment in the Department of Pathology of the University of Zürich School of Medicine, where she studied the biology and genetics of testicular cancer. Subsequently, she moved to the Burnham Institute for Medical Research in La Jolla, Calif., and focused her studies on the molecular aspects of male germ cell development. In 1995 joined the faculty at the University of Dayton, teaching cell biology and cancer biology. She joined the College in 2006.



Dr. Gee Lau

Assistant Professor, Pathobiology

- BS, University of Wisconsin-Madison. 1990
- MS, University of Wisconsin-Madison, 1992
- PhD, Purdue University, 1996

Research Interests: Functional genomics; virulence mechanisms and immunology of bacterial pathogen *Pseudomonas aeruginosa* in acute and chronic lung diseases, especially in cystic fibrosis airways; mechanisms of *P. aeruginosa* resistance to pulmonary innate immunity protein surfactant protein A (SP-A).

In 1996, Dr. Lau was accepted as a two-year postdoctoral research fellow at the Imperial College School of Medicine in London, England. He then completed a second postdoctoral research fellowship from 1998 to 2001 at Harvard Medical School in Boston, Mass. Over the past four years he has worked as a researcher and assistant professor at the University of Cincinnati Medical Center's Division of Pulmonary, Critical Care & Sleep Medicine.

"The reputation of the College of Veterinary Medicine is known worldwide. The large number of foreign students and scholars studying and contributing to the teaching and research enterprise here are testaments to the College's culture of excellence," says Dr. Lau. "It's a privilege to be a member of the College and University of Illinois community."

Mark Mitchell

Associate Professor, Veterinary Clinical Medicine

- BS, University of Illinois at Urbana-Champaign, 1990
- DVM, University of Illinois at Urbana-Champaign, 1992
- MS, University of Illinois at Urbana-Champaign, 1997
- PhD, Louisiana State University, 2001

Research Interests: Invertebrate, fish, amphibian, reptile, avian, and non-domestic mammal medicine and surgery, as well as conservation medicine and clinical issues in non-domestic species.

After completing a master's in clinical epidemiology Dr. Mitchell taught zoological medicine at Louisiana State University, where he also completed a PhD in wildlife epidemiology. Dr. Mitchell also served as the director of the Wildlife Hospital at Louisiana State University. In February he returned to Illinois as a member of the internal medicine faculty, with a focus on wildlife. Dr. Mitchell looks forward to mentoring future veterinary professionals, maintaining an active hand in clinical medicine, and researching aspects of conservation medicine and clinical issues in non-domestic species.

James Naughton

Visiting Clinical Assistant Professor, Veterinary Clinical Medicine

- DVM, Purdue University School of Veterinary Medicine, 2002
- MS, University of Illinois at Urbana-Champaign

Research Interests: The use of MRI with a gadolinium contrast agent to image early arthritic changes in canine and equine articular cartilage which are not visible with conventional imaging methods.

Dr. Naughton completed a rotating internship position at Washington State University's College of Veterinary Medicine in 2003. He then worked at a small

animal practice in Greenfield, Ind., until 2004. He has spent the past three years at the College completing a residency in imaging.

"The clinicians and staff at the College have been very pleasant to work with throughout my residency and I look forward to working with them as a faculty member," says Dr. Naughton.

Dongwan Yoo

Professor, Pathobiology

- DVM, Seoul National University, Seoul Korea, 1974
- PhD, University of Ottawa, Ontario Canada, 1988

Research Interests: Arteriviruses, specifically porcine reproductive and respiratory syndrome (PRRS) virus, which belong to a unique group of animal viruses, called the family *Arteriviridae* in the order *Nidovirales*.

After completing a PhD in animal virology at the University of Ottawa in Ontario, Dr. Yoo went on to do postdoctoral research at the Veterinary Infectious Disease Organization at the Western College of Veterinary Medicine in Canada. In 1995, he joined the virology faculty at the Ontario Veterinary College at the University of Guelph. There he began his work on the PRRS virus, which has become the major focus of his research.

"I am very much looking forward to working together with the people here and witnessing the future growth of the College," says Dr. Yoo.

More "New Faces" coming soon:

- R. Avery Bennett
- Carrie Breaux
- Kathleen Colgrove
- Olivier Dossin
- Wanda Gordon-Evans
- Jason Herrick
- Laura Kohrt
- William Laegreid
- Maureen McMichael

Student Scholars Present Research

The 2007 Phi Zeta Research Day, held on April 13, provided an opportunity for undergraduate and graduate students, veterinary students, interns, and residents to improve their presentation skills while sharing the results of their research. Phi Zeta is the national veterinary honor society that promotes high scholarship, research, and ethical standards in veterinary medicine.

Awards were given to the three best presentations in clinical and basic research.

- Arthroscopic Computed Tomographic and Radiographic Evaluation of Radio-Ulnar Incongruence in Labrador Retrievers, *Kahrma Wagner, Veterinary Clinical Medicine (VCM)* (3rd place, clinical)
- Assessment of LDH Nanoparticles for Delivery of Peptides and Nucleic Acids to Cells, *Louise Lee, VCM*
- Chondrogenic Capacity of Cells Isolated from Equine Synovial Fluid, *Yu-Wen Chen, VCM*
- Class 1 Integron Detection and Antibiotic Resistance in Salmonella Isolated from Swine Production Systems, *Sangeeta Rao, Pathobiology* (1st place, clinical)
- Cloning and Characterization of Equine Aggrecan, *Evelyn Caporali, VCM*
- Diagnosing Equine Carpal Bone Fractures from a Rapidly Prototyping Bimodel Created from CT Data, *Juli Breslin-Strange, VCM*
- Effect of Hyaluronic Acid and Triamcinolone on IL-1 Treated Chondrocyte Opellets, *Elysia Schaefer, VCM*
- Effects of Methylprednisolone and Glucosamine on Equine Chondrocyte Proteoglycan Metabolism In Vitro, *Britany Benson, VCM* (3rd place, basic science)
- Evaluation of a Gadolinium MRI Contrast Agent in Articular Cartilage Degeneration and Surface Defects, *Jim Naughton, VCM* (2nd place, clinical)
- Intraoperative Measurement of Parathyroid Hormone with a Rapid Assay in Dogs with Naturally Occurring Primary Hyper-Parathyroidism, *Kathleen Ham, VCM*
- Investigating the Anti-Neoplastic Effects of Intravenous Zoledronate in Cats with Oral Squamous Cell Carcinoma, *Jacki Wypij, VCM*
- Manipulation of the Life Cycle of *Toxoplasma Gondii, Haruno Sengoku, Pathobiology*
- Proliferation of Adult Sertoli Cells in a Conditional Knockout Mouse Lacking the Gap Junctional Protein Connexin 43, *Santhi Sridharan, Veterinary Biosciences (VB)*
- Proximodistal Alignment of the Canine Patella: Radiographic Evaluation and Association with Medial and Lateral Patella Luxation in Dogs, *Ayman Mostafa, VCM*
- Risk Factors for Rate of Osteotomy Healing in Dogs Treated with Tibial Plateau Leveling Osteotomy, *Tobin Eshelman, VCM*
- The Role of Aromatase in Mediating Uterine Response to Decidualization, *Amrita Das, VB* (2nd place, basic science)
- Tendon-Derived Progenitor Cells Can Differentiate Along Multiple Lineages, *Jennifer Barrett, VCM* (1st place, basic science)
- The Transcription Factor ERM (Ets-Related Molecule) Is Necessary in Both Spermatogonial Stem Cells and Sertoli Cells for Spermatogenesis, *Carla Morrow, VB*

Current Clinical Trials in the Veterinary Teaching Hospital

Full details at **www.vetmed.illinois.edu/vth/**

- Cranial Cruciate Ligament Disease in Labrador Retrievers
- Double-blinded, Placebo-controlled Study of Drug to Treat Dogs with Atopic Dermatitis.
- The Effect of Body Condition on Postoperative Recovery in Dachshunds with Intervertebral Disc Disease Treated with Surgery and Aggressive Physical Rehabilitation
- Evaluation of the Effects of Deramaxx® and Rehabilitation on Hind Limb Function in Lame Juvenile Dogs with Canine Hip Dysplasia
- Evaluation of a Novel Anticancer Agent in Dogs with Neoplasia
- Fructosamine Levels in Dogs with Hyperadrenocorticism Before and After Treatment
- Intra-operative Parathyroid Hormone Assay in Dogs with Naturally Occurring Primary Hyperparathyroidism
- Staging of Blastomycosis to Provide Prognostic Information
- Treatment for Canine Appendicular Osteosarcoma with a Novel Anticancer Agent
- Use of a New Human Medication to Treat Renal Secondary Hyperparathyroidism in Cats

Tom Schaefges

Research: The Gift that Changes Lives

By Brenda Betts

Tom Schaefges

Kelsey was "just" a mixed-breed dog, 90 pounds and tawny, but utterly devoted to her family: two kids and their parents, the father overseas in the military.

When Kelsey was diagnosed with bone cancer in her leg, her family was devastated. Then, for over a year, Kelsey came to the Veterinary Teaching Hospital two or three times every month for treatments that controlled the cancer pain and improved her bone stability.

Her owners told us that as soon as their car turned down the road to the hospital and Kelsey realized where she was going, she would quiver with excitement. She loved visiting her second family here, and she always got an outpouring of love from our students and staff.

Our oncologists were able to give Kelsey an extra year without pain to enjoy her family.

And Kelsey gave something in return. As a patient participating in a drug trial, Kelsey contributed to research that will help find better ways to care for patients with osteosarcoma.

If you are like me, you love to hear about animals whose lives were touched by the expert care of a veterinarian. But what makes the work done at our College truly transformative is the potential for new knowledge, developed here, to have an impact far beyond the patients seen in our hospital.

The research mission of the College reaches past the confines of the community, and even exceeds the influence of the hundreds of veterinary practitioners who are educated here.

Through research, our College is discovering how to improve diagnostics, cure diseases, and protect public health around the globe.

You may not be able to contribute to research in the way that Kelsey did, but there is a rewarding role that you can play.

As part of the Brilliant Futures campaign launched this year by the University of Illinois, our College is seeking donors whose vision extends along this global scale.

Here are a few of the giving opportunities available:

- An endowed chair in pathobiology to support infectious disease research that could find the key to controlling asthma and other immune system disorders.
- An endowed program in oncology that acquires a linear accelerator to assist cancer care and discovery.
- An endowed professorship in small animal emergency and critical care to support faculty who will conduct research and mentor specialists in this area.

By supporting programs such as these, you can make a lasting impact on the lives of an untold number of animals and people.

To discuss areas of interest to you, please contact me at any time. You can reach me at advancement@cvm.uiuc.edu.

Alumnus Thankful for Veterinary Start to Medical Career

Dr. Allan Graham and his wife Mary feel thankful for the good things that life has brought them. To express their gratitude, they recently decided to make a $500,000 gift to the College of Veterinary Medicine in support of the imaging program.

Growing up on a farm outside the town of Ursa, in western Illinois, Dr. Graham was very impressed with Dr. Charles Lantis, the veterinarian who cared for his family's animals. Young Allan decided to pursue a veterinary career.

After completing his undergraduate studies at the University of Illinois at Urbana-Champaign, Dr. Graham enrolled in the College's third veterinary class, the Class of 1954.

He applied to the Class of 1953 but was not admitted because he was not a veteran. But he spent that year at the College even so: "I got a job working for Jesse Sampson, the physiology professor, in the old building," he recalls. "I had to set up the physiology experiments to make sure they worked before the students tried them."

By the time he reached his junior year, Dr. Graham had developed a keen interest in medicine—and the desire to become a medical doctor. One of his veterinary professors, Dr. L.E. St. Clair, encouraged him to follow his interest. The draft board, on the other hand, said *not yet*. He needed to finish the DVM program and complete two years of military service first.

Eventually he went on to medical school at the University of Illinois at Chicago, an internship, residency, and fellowship, and a very successful career as a thoracic and cardiovascular surgeon in Texas, where Dr. and Mrs. Graham have lived for the past 40 years.

Dr. Graham excelled in both curricula, earning membership in the Alpha Omega Alpha medical honorary society and the Phi Zeta veterinary honorary society.

Throughout his career, Dr. Graham continued to feel connected to his veterinary classmates. In 1994 the Grahams attended the fortieth reunion of the Class of 1954.

"I saw the guys I went to school with," he recalls. "They are terrific people. I got to see what's happened at the College, including all the new buildings. It's a fantastic program."

After expressing an interest in giving back to the College and reviewing a number of opportunities to make a difference with a gift, the Grahams decided to support the burgeoning imaging program here. Their generosity will have an impact on patient care, teaching, and scholarship in the imaging and oncology programs at the Veterinary Teaching Hospital.

"We looked at various programs and decided that this is where we could most be of help," says Dr. Graham.

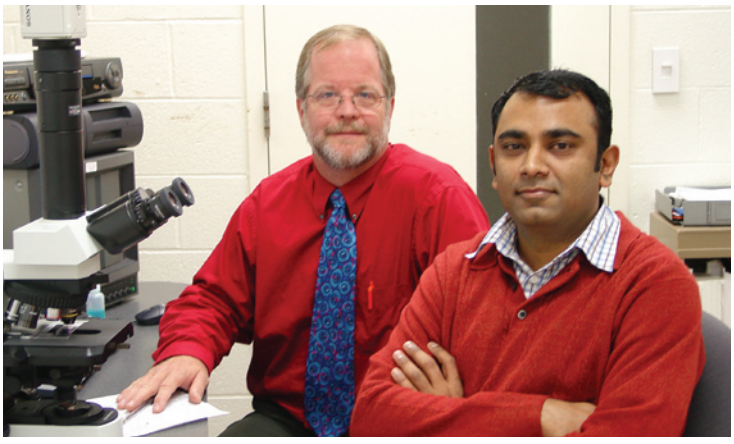
Coalition Channels Industry Support for Veterinary Pathology Training

By Sarah Dowling

Veterinary pathologists and toxicologists play a crucial role in research, industry, and governmental settings, and the supply is not keeping up with the demand for these valuable professionals. In response to this shortage, the American College of Veterinary Pathologists and the Society of Toxicologic Pathology created the Coalition for Veterinary Pathologist Fellows.

The coalition aims to support and create new training positions for students interested in entering this field. Through the coalition, the College received funding for a new anatomical pathology residency position from GlaxoSmithKline, the second-largest pharmaceutical company in the world, which has headquarters in the United Kingdom and operations based in the United States. Dr. Sandeep Akare was

continued on page 20



Dr. Matthew Wallig *(left)*, coordinator of the anatomic pathology residency program, with Dr. Sandeep Akare.

College of Veterinary Medicine Faculty

Names in bold indicate section leaders.

Department of Pathobiology

Daniel L. Rock, *head*

Research focus on infectious disease research: pathogen-host interactions and the ecology of infectious disease.

Comparative Pathology
Anne M. Barger*
Wanda M. Haschek-Hock*
Michael J. Kinsel+
William Laegreid
Carol A. Lichtensteiger*
Amy MacNeill*
Milton M. McAllister
Philip F. Solter
Karen Terio+
Victor E. O. Valli*
Matthew A. Wallig*
Herbert E. Whiteley
James F. Zachary

Epidemiology & Preventive Medicine
Lawrence D. Firkins
Thomas R. Gillespie
Tony L. Goldberg
Uriel D. Kitron
Gay Y. Miller
Marilyn O. Ruiz
Ronald M. Weigel

Microbiology & Immunology
Edwin C. Hahn, III
Lois L. Hoyer
Ibulaimu Kakoma
Mark S. Kuhlenschmidt
Gee W. Lau
Carol W. Maddox*
Daniel L. Rock
Gail Scherba*
Mariangela Segre
Eric R. Vimr
Dongwan Yoo
Federico A. Zuckermann*

Parasitology
Allan J. Paul*

* Indicates a joint appointment in the Veterinary Diagnostic Laboratory.
\+ Indicates a joint appointment in the Chicago-based Zoological Pathology Program, operated through the Veterinary Diagnostic Laboratory.

Department of Veterinary Biosciences

Duncan C. Ferguson, *head*

Research focus on environmental toxicology and on reproductive biology / stem cell research.

Morphology
Suzanne Berry
Paul S. Cooke
Jason Herrick
Rex A. Hess
Gary A. Iwamoto
Antony Onyango Oluoch
Gerald J. Pijanowski

Pharmacology / Toxicology
Val R. Beasley
Levent Dirikolu
Duncan C. Ferguson
Jodi A. Flaws
Marie-Claude Hofmann
Joan S. Jorgensen
Susan L. Schantz

Physiology
Indrani C. Bagchi
David Bunick
Aslam S. Hassan
Murli Manohar
Humphrey Hung-Chang Yao

Department of Veterinary Clinical Medicine

David A. Williams, *head*

Research focus on endocrinology/obesity/glucose homeostasis; orthopedic biology/stem cell research; zoological medicine.

Community Health and Preventive Medicine
John A. Herrmann
Yvette J. Johnson
Dawn E. Morin
H. Fred Troutt
Richard L. Wallace

Equine Medicine
James P. Brendemuehl
Christopher R. Byron
Natalie Coffer
Jonathan H. Foreman
Thomas E. Goetz
Allison A. Stewart
Matthew C. Stewart

Farm Animal Reproduction, Medicine and Surgery
Sherrie G. Clark
Natalie Coffer
Edgar Garrett
Clifford F. Shipley
Manoel A. Tamassia

Small Animal Medicine
Julie K. Byron
Olivier Dossin
Thomas K. Graves
Jennifer N. Langan
Maureen McMichael
Mark A. Mitchell
Marcella D. Ridgway
Debra S. Sauberli
David A. Williams
Julia K. Whittington

Small Animal Surgery
R. Avery Bennett
Wanda Gordon-Evans
Cathy L. Greenfield
Dominique J. Griffon
Ann L. Johnson
Sandra Manfra Marretta

Specialty Medicine
Carrie Breaux
Karen L. Campbell
Rachael E. Carpenter
Stuart Clark-Price
Timothy M. Fan
Laura Garrett
Ralph E. Hamor
James F. Naughton
Kristen O'Dell-Anderson

Veterinary Diagnostic Laboratory

Susan Ball-Kell
Kathleen Colgrove
Richard L. Fredrickson
Walter E. Hoffmann, *interim director*
Laura Kohrt

Veterinary Teaching Hospital

Michael Biehl, *director*
Arthur M. Siegel, *assistant director*

Industry Support, continued

awarded this position, which continues through 2009.

Dr. Akare, who has a PhD from the Indian Veterinary Research Institute in Izatnagar, India, and who conducted post-doctoral research at the Arizona Cancer Centre at the University of Arizona for three years, has extensive experience in the field of cancer biology.

Dr. Matthew Wallig, coordinator of the anatomic pathology residency program and adviser for the student chapter of the ACVP, says that Dr. Akare's outstanding experience and background made him highly qualified for the position.

"Dr. Akare's intense desire to do something more than *in vitro* culture work was what most impressed the College. He feels that it is important to take the knowledge garnered in the lab and translate that to changes in the whole animal," says Dr. Wallig. "He sees veterinary pathology as the 'ultimate tool' in scientific research."

Dr. Richard A. Peterson II, director of Molecular and Ultrastructural Pathology in the GlaxoSmithKline Molecular and Ultrastructural Pathology Group, will serve as the industry mentor to Dr. Akare.

"I will provide insight into the role of veterinary pathology in the pharmaceutical industry and preclinical drug development, direct Dr. Akare's externship experiences at GlaxoSmithKline, and provide guidance in his career development," says Dr. Peterson. "With a proposed special faculty appointment, I also look forward to interaction with other trainees not directly associated with the Coalition."

"Dr. Akare has solid teaching experience and experience with curriculum development, which further enhances his potential, not just as a future researcher in veterinary pathology but as an educator as well," adds Dr. Wallig.

Seminars Focus on Health Issues Bridging Human-Animal Gap

Stem cell therapy, cross-species infectious disease, and ecosystem health are topics addressed during the fall seminar series on translational biomedical research—inter-disciplinary collaborations that "translate" fundamental research discoveries into practical biomedical applications to improve human and animal health and society.

The seminars, held on Mondays at noon on the College campus, are free and open to the public. Veterinarians can earn one hour free continuing education credit by attending.

The lineup includes speakers from Ghent, Belgium; Saskatoon, Canada; Edinburgh, U.K.; Basel, Switzerland; and Valencia, Spain.

For the full schedule see **http://www.cvm.uiuc.edu/research/tbrseries.html.**

November

12 **Mucosal vaccination and immunity,** TBR seminar by J. A. Ellis, University of Saskatchewan,

19 **Strengthening health systems: the potential of cooperation between human and animal health,** TBR seminar Jakob Zinsstag, Swiss Tropical Institute.

26 **Emerging Diseases in Marine Mammals,** Greg Bossart, Harbor Branch Oceanographic.

December

6-7 **Executive Veterinary Program,** Urbana, Ill. A two-year certificate program. See http://www.evpillinois.org/

January

20 **Alumni Reception at the North American Veterinary Conference,** Orlando. Fla. E-mail advancement@cvm.uiuc.edu.

February

2 **Horseman's Clinic,** Urbana, Ill. See www.vetmed.illinois.edu/ope/horseclinic/.

18 **Alumni Reception at the Western Veterinary Conference,** Las Vegas, Nev. E-mail advancement@cvm.uiuc.edu.

April

5 **Veterinary Medicine Open House,** Urbana, Ill. See www.vetmed.illinois.edu/openhouse/.

12 **Awards and Scholarships Celebration,** Urbana, Ill. E-mail advancement@cvm.uiuc.edu.

19 **Doodle for Wildlife,** Urbana, Ill. Contact the Advancement Office, 217/333-2762.

For more College events listings, visit www.vetmed.illinois.edu

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Veterinary Report
University of Illinois
College of Veterinary Medicine
3225 VMBSB, 2001 South Lincoln Avenue
Urbana, IL 61802

PHONE: 217/333-2762
FAX: 217/333-4628

EMAIL: editor@cvm.uiuc.edu
WEB SITE: www.vetmed.illinois.edu

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Writers
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Graphic Design
Studio 2D

Photographers
Nick Mann, Tom Schaefges

Printed with soy ink.

Summer Program Teaches Students Essential Research Skill: Teamwork

By Debra Domal

"All science nowadays is collaborative in nature," notes Dr. Brenda Wilson, associate professor of microbiology and co-director of the University of Illinois Center for Zoonoses Research.

Given that observation, the College's summer research training program for veterinary students, now in its fifth year, decided to foster more realistic laboratory and field-work experiences. The students who participated in team-based projects came out winners.

Dr. Wilson mentored second-year students Jennifer Reinhart and Dusty Sachen.

"Their joint project gave them exposure to a 'real-life' scientific experience: planning experimental design, executing the laboratory experiments, interpreting the data, and reporting the data," says Dr. Wilson.

Reinhart and Sachen collaborated on a study of 17 Illinois horses that exhibited botulism-like signs, including flaccid paralysis. Bacterial isolates from necropsy, fecal, and environmental samples had been submitted to the College's Veterinary Diagnostic Laboratory. The laboratory isolated *Clostridium sp*. but was unable to conclusively determine the presence of a toxin gene. The students' goal was to more specifically identify the strains of *Clostridium* present in the samples and to isolate and identify the responsible toxin gene.

Working together in the lab, the students amplified DNA segments using universal bacteria primers, then cloned and sequenced the DNA and compared it with an established database to identify three species of *Clostridium*.

Reinhart says the program expanded her idea of research, and she'd like to incorporate research in her future career.

Illinois veterinary students Annie Lo and Anna Czekala pose with Alice and her children, members of a Ugandan family involved in the monkeypox study.

"It's given me a taste of a different kind of lab work," she notes.

Reinhart and Sachen placed second in the scientific poster session that capped the summer research program.

Collaboration meant something very different for third-year veterinary students Anna Czekala and Elizabeth Falendyz, who worked together despite being an ocean apart.

In a study of transmission pathways for the monkeypox virus, Czekala spent the summer in Uganda collecting samples from dormice. Meanwhile, Falendyz, a veterinary student at the University of Wisconsin, was stationed at the Centers for Disease Control and Prevention in Atlanta,

continued on page 11

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